REMARKS/ARGUMENT

This letter is responsive to the Office Action mailed on April 13, 2004. The claims have been amended in response to the outstanding Office Action. No new matter has been added by the amendments.

Claims 1 to 7, as amended, are currently pending in the application.

Claims 1 to 5 and 7 are rejected under 35 U.S.C. §102(b) in view of Fisher

The Examiner has rejected claims 1 to 5 and 7 under 35 U.S.C. §102(b) as being anticipated by Fisher (U.S. Patent No. 6,040,752).

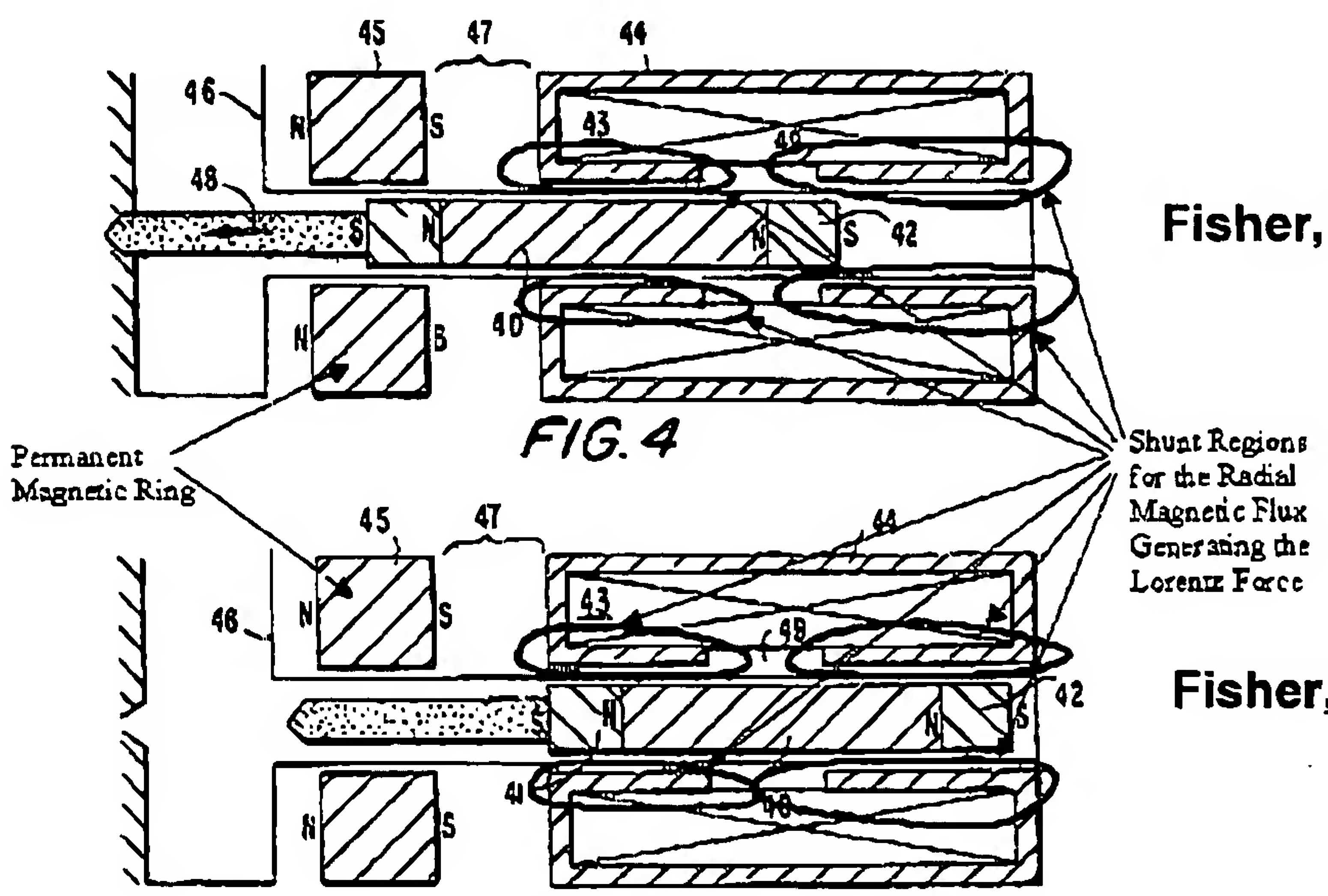
Specifically, the Examiner states that the Fisher reference discloses a linear switch actuator (Fisher, FIGS. 4 and 6) for actuating a moveable element having a soft iron yoke (44), a magnetic coil (43) positioned within the yoke (44), and a moveable armature assembly (40, 41, 42) adapted to be coupled to the movable element. The moveable armature assembly includes a soft-iron armature (40) having permanent magnets (41 and 42) at its ends with opposite pole orientations and being movable between a first stroke end position (Fisher, FIG. 4) and a second stroke end position (Fisher, FIG. 6).

In response, the Applicants have amended claims 1 to 7 to better clarify the distinction between the present invention as claimed and the cited prior art references.

Independent claim 1, as amended, defines a linear switch actuator having a ferromagnetic shield having a hollow tubular portion and first and second end plates, where first and second apertures are formed within said first and second end plates, and where the shield defines <u>a single and uninterrupted internal region that extends between the inside surfaces of the hollow tubular portion</u>. A magnetic coil (16) is

positioned within the interior region. A moveable armature assembly (12, 14a, 14b) having two permanent magnets (14a, 14b) at the ends is positioned along the longitudinal axis of the coil (16) and extends through the first and second apertures of the shield (18). Support for these amendments are provided in the subject disclosure (Disclosure, page 9, line 3 to page 13, line 20 and FIGS. 4, 5A, 5B, 6, 7A, 7B, and 7C).

The electromagnetic actuator (Fisher, abstract) of Fisher uses a solenoid (43) positioned within a yoke (44) having shunt regions (as shown in Fisher, FIG. 4 (annotation U) and Fisher, FIG. 6 (annotation V) below) as well as a permanent magnet ring (45) to move an actuator (40, 41, 42) between two positions.



Fisher, FIG. 4 (annotation U)

Fisher, FIG. 6 (annotation V)

FIG. 6

Fisher's ferromagnetic yoke (44) includes shunt regions (as circled above in Fisher, FIG. 4 (annotation U) and Fisher, FIG. 6 (annotation V)) on either side of the gap (49). These shunt regions are necessary for the proper operation of Fisher, as will be described.

In conventional electromagnetic actuators like the one disclosed in Fisher, active forces are generated by the air-gap magnetic flux of the electro-magnet. This phenomenon is discussed in Fisher and in the subject disclosure, (Disclosure, page 2, lines 11 to page

3, line 3, and FIG. 1). Within the electromagnetic actuator of Fisher, the radial magnetic flux is detrimental to the operation of the actuator. The circled shunt portions of the yoke (44) (shown above) shunt the radial magnetic field that would otherwise flow from the armature assembly through the coil and to the outer wall of the yoke (44). The shunt regions serve to collect magnetic flux, otherwise traversing radially across the solenoid (43), and introduce it directly into the yoke (44) through the axial ends of the yoke (44). By means of the shunt regions, the yoke (44) presents discrete pole surfaces to the moving armature (40, 41, 42) such that the magnetic influences of both the yoke (44) alone (unpowered) and the yoke (44) and solenoid (43) combination (powered) are defined in terms of the magnetic state of the ends of the yoke (44).

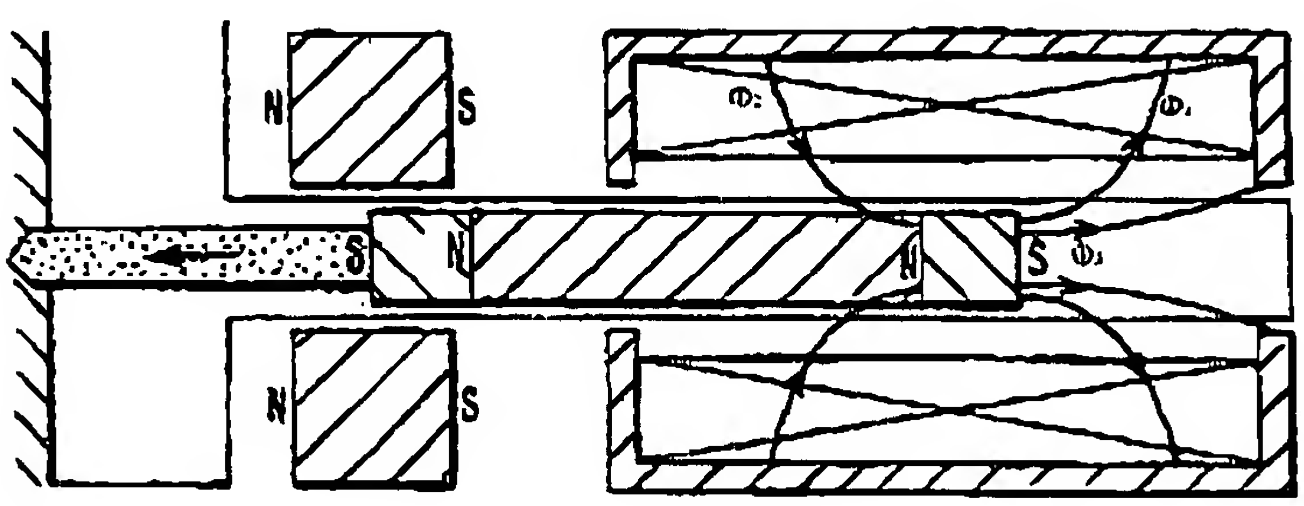


FIG. X: Magnetic flux path in Fisher actuator where the shunt regions of yoke (44) are <u>hypothetically</u> removed

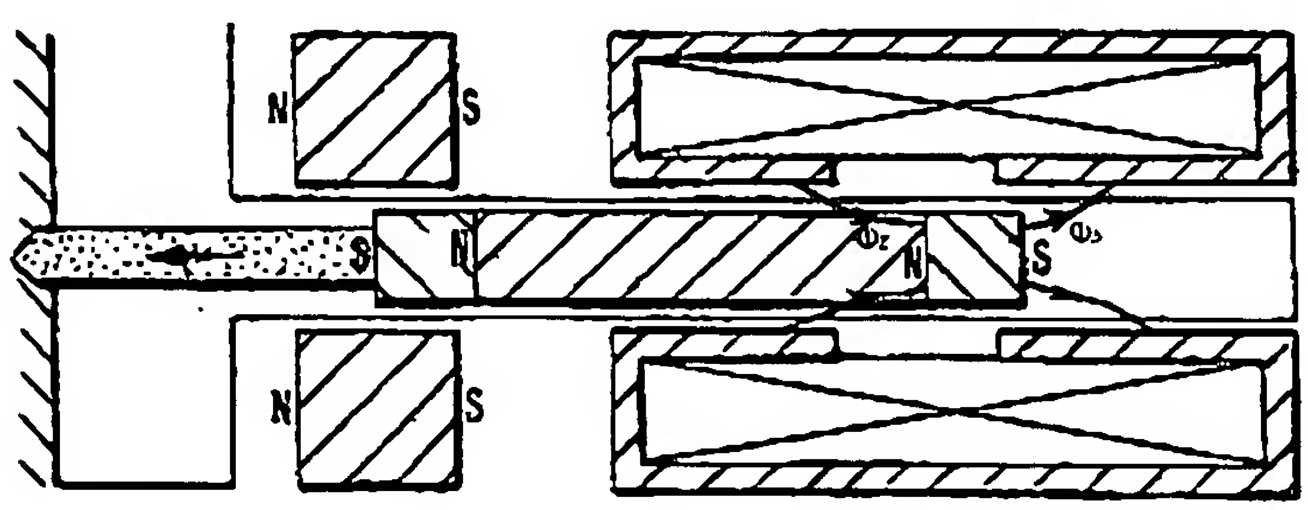


FIG. Y: Magnetic flux path in Fisher actuator showing yoke (44) having disclosed shunt regions

For discussion purposes, the shunt regions of yoke (44) will be hypothetically removed as shown in FIG. X above. In FIG. Y above, the yoke (44) is shown having shunt regions as disclosed throughout the Fisher reference. As shown in FIG. X, the air-gap flux Φ_3 (which generates the active force) is reduced by the leakage flux Φ_1 that crosses the solinoid (43). The flux Φ_1 creates a Lorentz force opposed by the Lorentz force created by the flux Φ_2 (Φ_2 is opposed in sign to Φ_1). The total active force is primarily created by the flux Φ_3 (as diminished by the flux Φ_1). FIG. Y shows how the Fisher

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actuator (along with other conventional electromagnetic actuators) uses the shunt regions on yoke (44) to eliminate the unwanted effects of Φ_1 and Φ_2.

In contrast, the open shield structure as defined by claim 1 of the present invention, as amended, allows the radial magnetic field generated by the permanent magnets to flow from the armature assembly through the coil (16) to the shield (18). This results in a radial magnetic field flowing from the armature assembly to the shield that generates Lorentz force. Since the shield (18) of the present invention provides a single and uninterrupted internal region that extends between the inside surfaces of the hollow tubular portion, the radial magnetic field flows from the armature assembly through the coil (16) and to the outer wall of the shield (18) (Disclosure, page 12, lines 8 to 25).

As shown in FIG. Z below, the actuator (10) of the subject invention is bi-stable and during operation, both armature magnets are always positioned substantially outside of the shield (18). Flux components Φ_1 in the subject actuator (10) (similar to Φ_1 shown in the annotated X version of Fisher FIG. 4) are shunted by the end-caps (19) while components Φ_2 (similar to Φ_2 shown in the annotated X version of Fisher FIG. 4) produce useful Lorentz force that is added to the other magnetic forces shown increasing the active force developed by the actuator (10).

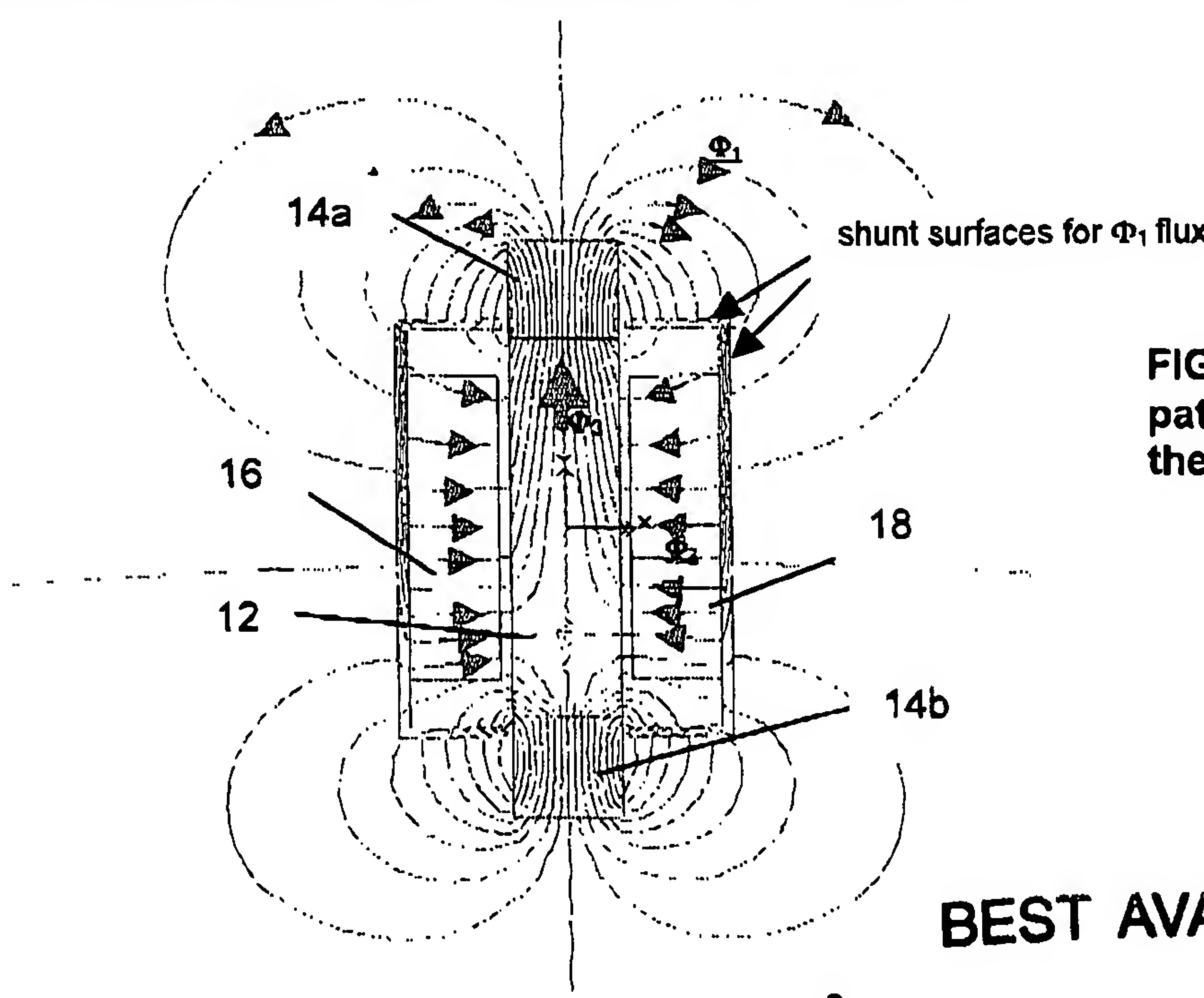

FIG. Z: Magnetic flux path in actuator 10 of the subject invention

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Accordingly, the actuator (10) benefits from the flux components Φ_2 that are allowed to flow within the ferromagnetic shield (18) of the present invention since the shield (18) has a single and uninterrupted internal surface that extends between the inside surfaces of the hollow tubular portion.

It is submitted that the actuator disclosed in Fisher does not disclose the use of a shield (yoke) that defines a single and uninterrupted internal region extending between the inside surfaces of the hollow tubular portion. Rather, the yoke (44) includes shunt regions (as circled in Fisher FIGS. 4 and 6 above) in order to shunt the radial magnetic field that would otherwise flow from the armature assembly to the yoke (44).

Further, the specific design of the shield (18) of the present invention allows for the generation of enough force for the entire stroke of the actuator (i.e. complete latching) without any need for a permanent magnetic ring or other auxiliary spring elements that prior art designs (including Fisher) use. Specifically, the Φ_1 type flux that is shunted by the end-caps (19) and the shield (18) of the present invention, generates magnetic latching in both stroke end positions. In Fisher, unwanted flux Φ_1 adds to the energy losses while in the case of the present actuator (10), the flux Φ_1, is utilized to generate latching action. The result is that the actuator of the present invention is much smaller and more efficient that the Fisher actuator. In space applications, additional elements (e.g. magnetic rings) render such actuators unusable due to larger volume and mass.

Accordingly, the Applicant respectfully submits that the subject matter claimed in independent claim 1, as amended, is not shown nor suggested by the Fisher reference. It is further submitted that dependent claims 2 to 7, recite additional patentable features that are neither taught nor suggested by the Fisher reference. Withdrawal of the Examiner's rejection in respect of claims 1 to 7 is respectfully requested.

Claim 6 rejected under 35 U.S.C. §103(a) in view of Fisher

The Examiner has rejected claim 6 under 35 U.S.C. §103(a) as being anticipated by Fisher (U.S. Patent No. 6,040,752).

Specifically, the Examiner states that it would have been obvious to one skilled in the art at the time the invention was made to use a bifilar wire in order to create a coil that can be energized in the clockwise and counter-clockwise orientation using the same control pulse on either of the two wire strands.

The Applicant submits that for the reasons discussed above in respect of claim 1, as amended, that the subject matter claimed in dependent claim 6, as amended, is not shown nor suggested by the Fisher reference. Withdrawal of the Examiner's rejection in respect of claim 6 is respectfully requested.

References Made of Record and Not Relied Upon

The Applicant has briefly reviewed the other references cited by the Examiner. The Applicant respectfully submits that these references do not recognize the problem solved by the present invention and do not describe or even suggest the present invention. The Applicant respectfully submits that they are not relevant to the patentability of the claims of the present invention.

In view of the foregoing, the Applicant respectfully submits that the application is now in condition for allowance. If the Examiner believes that a telephone interview would expedite allowance of the application, the Examiner is respectfully requested to contact the undersigned at (416) 364-7311.

Respectfully submitted,
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